Section 4. Setting the X-Factor for the Provisional Price Cap

As indicated earlier, a distinct advantage of the proposed price cap based on competitive system prices is that it does not require an x-factor. However, if the Commission decides to go forward with a price cap based on GNPPI ("provisional price cap"), it must address this issue. The Commission solicits comment on how to determine the appropriate x-factor for cable price cap regulation (Notice, Para. 85). It is important to clarify the appropriate concept of productivity in the context of the provisional price cap, before any measurement issues are discussed. The productivity adjustment factor is designed to reflect the differential between the rate of growth of *total factor productivity* for the cable industry and the economy as a whole. It is entirely wrong to use any measure of partial productivity (e.g., labor productivity) to set the x-factor. All such measures are incompatible with the economic foundations of the price cap and fail to satisfy the basic compensation principle discussed in Section 2.[29]

In MM Docket No. 92-266, the Commission provisionally adopted an x-factor of zero. This was justified partly on the claim that productivity gains resulting from increased cable system capacity are reflected in the benchmark procedure, which sets per channel rates that decline with the number of channels and subscribers (see also Notice, footnote 97, p. 46). This reasoning is incorrect because it does not distinguish

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[29] See the technical appendix and Section 2 in this statement for a more detailed discussion. Partial productivity measures have been used to compare efficiency levels of in the telephone and cable industries (see Continental Cablevision Comments in MM Docket No. 92-266, Appendix C, pp. 11-12). The Commission itself, in Para. 84 of the Notice, hints at the possibility of using partial productivity measures to set the x-factor. This approach definitely should be rejected.

between differences in the level of unit cost across systems due to capacity differences, and changes in unit cost over time for any given system due to growth in capacity. The benchmark procedure involves setting the initial price for regulated cable systems according to some measures of the initial system size which are presumed to affect unit cost - that is, locating each cable system at the "right" point along the declining unit cost curve. This procedure only captures (at best) the effect of scale economies on the *initial level* of competitive prices. However, the growth in TFP due to scale economies is realized when system capacity *expands* - that is, cost reductions arising from each system moving down along the unit cost curve.[30] These are entirely separate issues. The benchmark relates to the initial level of TFP (unit cost), whereas the productivity offset relates to the growth in TFP. Therefore, the benchmark procedure itself provides no support for setting a zero productivity offset.

If the Commission chooses to retain the provisional price cap, it should definitely impose a positive productivity offset. Development and deployment of advanced computer and communications technology in the cable industry are providing more efficient capital inputs and opportunities for system reconfiguration to produce further productivity gains.[31] To my knowledge, there are no published studies of TFP growth for the cable industry during the last decade. Even in the absence of

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30 Productivity gains due to technology changes are reflected by downward shifts in the cost curve itself.

31 For example, replacement of coaxial by fiber reduces amplification-transportation costs, reduces outage frequency, improves reception quality, and enhances ability to increase bandwidth and hence program capacity. Addressable CPE provides functionality that allows for service reconfiguration and reduces customer service response time.

such studies, however, it does not meet the common sense rule to assume that the potential for TFP growth for the cable industry is the same as for the economy at large, which includes both low and high technology industries. The strong presumption should be in favor of a positive productivity offset of roughly the same magnitude as technologically similar industries.

No comparison with other industries will be above criticism. Nonetheless, in my opinion the most defensible approach at this stage is to use the TFP performance of LECs as the yardstick for monopoly cable operators. There is already very substantial similarity in the underlying technology (capital goods) in the two industries, and increasing convergence in terms of technological capability and potential service provision. The extensive use of fiber optics for transmission from the head end to the neighborhood, switch links among head ends, addressable converters, and digital compression technology all blur the distinction between cable and telephony in terms of providing two-way voice and data communication.[32]

On the basis of these considerations, I recommend that the Commission set the x-factor at 3.3 percent for the provisional price cap. Until direct studies of TFP growth for the cable industry are available, evaluated and substantiated, the Commission should continue to use the LEC productivity offset for the cable price cap.

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[32] For example, the Cable Loop Carrier-500 system developed by AT&T Network Systems and Antec (U.S. trials planned for late 1993), as announced, will allow telephone and cable companies to deliver both telephone and video services over the same fiber and coaxial cable networks now used to distribute cable TV. Communications Daily, July 28, 1993, p. 7. U S West and Time Warner intend to deploy telephone services over their cable TV facilities. Petition of Time Warner Entertainment Company, L.P. and U S West Communications, Inc. for Temporary Waiver of Section 63.54 of the Commission's Rules, May 26, 1993, at page 3.

Some commentors suggest that there are "embedded inefficiencies" in the telephone industry (and not in cable) which justify a lower productivity offset for cable. This conclusion should be rejected for two reasons. First, there is no direct evidence in the record on TFP growth in the telephone and cable industries to support the claim.[33] In fact, LECs have been making considerable efforts to streamline and restructure both in response to regulatory reform at the state and federal level and in anticipation of intense competition from "full service network" cable companies and other communications firms. Second, the Cable Act applies regulation only to *monopoly* cable systems, not competitive operators. These monopoly cable systems have not been subject to the normal competitive pressures for efficient operations and may themselves have considerable scope for technical efficiency gains.

Programming costs are also cited as a reason not to use LEC productivity growth as the yardstick for cable companies. There is evidence in the record that programming costs rose faster than aggregate inflation, but this is not sufficient basis for rejecting the LEC productivity yardstick. It must be remembered that the growth of programming *inputs* (costs) produced a correspondingly rapid expansion of program diversity which is one important dimension of the *output* of cable companies. Therefore, the rapid rise in programming costs may well have contributed to faster

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[33] Evidence based on measures of partial productivity (e.g., employees per access line) is not germane and cannot be used to establish the claim. For an example of such evidence, see supra note 28.

rather than slower TFP growth for the cable industry.[34] Until direct empirical studies of TFP growth (encompassing all relevant dimensions of output including program diversity) are available, no conclusion can be drawn with respect to how program costs have affected cable productivity. Until then, I continue to recommend the use of the LEC productivity offset as the yardstick for the cable price cap.

Conclusion

This statement discusses the economic foundations for proper design of price caps and makes specific recommendations in the context of cable regulation. Three central recommendations are developed. First, I propose a price cap that uses the output prices for competitive (unregulated) cable systems to constrain monopoly cable rates. This formulation of the price cap embodies the Congressional directive to rely on the competitive market standard to the maximum extent feasible. Moreover, this price cap eliminates the need to determine a productivity offset for the cable industry, provides appropriate incentives for efficient operation, meets the objective of regulatory simplification, and can be easily implemented. However, in the event that the Commission decides to retain the price cap provisionally adopted in MM 92-266, I

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[34] The rapid rise in programming costs may have been partly a short run phenomenon, caused by sharp increases in the demand for programming by cable companies in the face of relatively inelastic short run program supply. There is some anecdotal evidence consistent with this hypothesis. In bargaining on retransmission versus must-carry, some programmers (e.g., Fox, NBC, and Capital/ABC) have recently opted for broadcast must-carry with the proviso that cable companies accept their other programming channels. Communications Daily, Aug. 1, 1993, p. 5 and Aug. 19, 1993, p. 4. This suggests excess supply, not excess demand for programming.

recommend that the x-factor be set at the same level (3.3 percent) as the price cap for LECs pending availability and evaluation of cable specific TFP studies. Second, I recommend that the Commission very strictly limit the use of cost of service hearings for rate relief, regardless of the price cap selected, by adopting an earnings floor mechanism as the safeguard to protect regulated cable operators from prolonged low earnings. Finally, I recommend that the Commission improve the benchmark procedure by including a fuller set of cost-determining characteristics in the econometric model. Benchmark cable rates should then be reset on the basis of the revised model and subjected to the recommended competitive price cap going forward.

Appendix. Technical Derivation of Price Cap Mechanism

This appendix presents the technical derivation of the proposed price cap. The analysis is conducted for the general case of a multiple input-multiple output firm (specialization to the single product firm is straightforward). It should be noted that the derivation also holds for an industry or the economy as a whole, under the stated assumption, by suitably redefining the unit of analysis.

In Section A.1, I derive the price cap formula without reference to the important incentive problem of how to promote productivity growth and economical input use. These critical incentive issues are introduced in Section A.2 and the final proposed revenue cap incorporating the necessary modifications is presented.

Section A.1. Baseline Price Cap

Consider a firm which produces some set of N outputs using M inputs. Denote the outputs as y_i and the inputs as x_j where (i=1,...,N) and (j=1,...,M). Note that the list of inputs contains all factors used in the production process, including capital. Let p_i represent the unit output price for y_i and w_j denote the unit input price for x_j. Define

total revenues as $R = \sum_{i=1}^{N} p_i y_i$ and total costs as $C = \sum_{j=1}^{M} w_j x_j$.

The only assumption required for this analysis is that the level of supernormal profits (above the opportunity cost of capital) the firm earns is some constant proportion of its revenues. Letting π denote the level of supernormal profits,

(1) $\pi = f\,R$ for any constant $f \geq 0$

This is a mild assumption. It does not impose any particular profit rate (the special case of normal profits is $f = 0$). Using the definition $\pi = R-C$, Equation (1) can be rewritten as:

(2) $(1-f)\,R = C$

Substituting the expressions for revenues and costs, Equation (2) becomes:

(3) $$(1-f)\sum_i p_i y_i = \sum_j w_j x_j$$

Totally differentiating Equation (3) with respect to time yields:

(4) $$(1-f)\left[\sum_i \dot{p}_i y_i + \sum_i p_i \dot{y}_i\right] = \sum_j w_j x_j + \sum_j w_j \dot{x}_j$$

where a dot over the term represents the derivative of that variable with respect to time. Dividing by Equation (2), I can rewrite Equation (4) in terms of rates of growth of the variables in the following way:

$$(5) \qquad \sum_i v_i dp_i + \sum_i v_i dy_i = \sum_j s_j dw_j + \sum_j s_j dx_j$$

where the prefix "d" denotes a rate of growth (*e.g.*, $dp = \dot{p}/p$). Also, $v_i = p_i y_i / R$ is the revenue share of output i and $s_j = w_j x_j / C$ is the cost share of input j. Rearranging Equation (5) yields:

$$(6) \qquad \sum_i v_i dp_i = \sum_j s_j dw_j - \left[\sum_i v_i dy_i - \sum_j s_j dx_j\right]$$

Writing Equation (6) in simplified notation,

$$(7) \qquad dp = dw - [dy - dx]$$

The term dp is the (revenue-share) weighted average rate of growth of output prices, which I refer to as *composite output price growth.* The term dw is the (cost-share) weighted average rate of growth of input prices, or *composite input price*

growth. The terms dy and dx represent the weighted average rates of growth of output and input quantities, respectively. Since the level of Total Factor Productivity (TFP) is defined as the ratio of the quantity of composite (weighted average) output to composite input, the expression dy – dx is simply the rate of growth of TFP, denoted dTFP. Therefore,

(8) $dp = dw - dTFP$

Equation (8) summarizes the baseline price cap formula, ignoring the incentive features which are incorporated in Section A.2. This equation denotes that output price growth should equal input price growth minus the rate of growth of TFP, where all growth rates are constructed as appropriate weighted averages. The price changes described by this equation would just compensate the company for changes in its real cost of production. This is referred to in the text as the "*compensation principle*."

Note that this derivation does *not* require any assumption about cost minimization, output prices based on marginal cost, or the absence of economies of scale or scope in the production function. These additional assumptions may be required if one wishes to interpret dTFP only as the shift in the underlying production frontier facing the firm ("technical change"). This is the interpretation commonly given in the economics literature. However, it is important to emphasize that in the context of the price cap, the role of the TFP term is to capture *all* changes in the firm's production cost other than those due to input price changes, including both cost

savings due to economies of scale and scope as well as shifts in the production frontier.

Section A.2. Incorporating Incentives Features

Version 1. In the baseline formulation in Equation (8), the company's allowable growth in output price is related directly to the change in its input prices and inversely to its TFP growth. This formulation does not provide any incentives to the regulated company to minimize production costs (e.g. by economical input choice) or to generate long term productivity growth. To provide such incentives, it is necessary to replace the company-specific input price and TFP components in the price cap with *external yardsticks or targets* that are not affected by the company's own decisions and performance. The choice of appropriate yardsticks for input price and TFP growth depends heavily on the structure of the industry and the type of information that is available.

Let the subscripts "m" and "t" denote the regulated monopoly supplier (hereafter, monopolist) and the chosen external yardstick ("target"), respectively. Then the general form of the price cap with incentive features is:

$$(9) \qquad dp_m = dw_t - dTFP_t$$

The use of yardsticks in the price cap provides incentives to economize on inputs (restrain input price growth) and to promote TFP growth. For example, if the monopolist is able to exceed the target TFP growth, then the output price change

allowed by the price cap exceeds the level necessary to compensate the company for the change in its cost of production [the latter is given by Equation (8)]. The price cap thereby generates an increase in net earnings for the regulated company, and it is this reward which represents the incentive to increase productivity in the first place. Conversely, failure to achieve the target TFP growth penalizes the monopolist. A symmetric argument holds for input prices. Because efforts by the monopolist to restrain input costs beyond the change reflected in the target do not affect the allowed price change under a price cap based on external yardsticks, there is an incentive to pursue such efforts and a penalty for unsuccessful performance.

Version 2. The price cap in Equation (9) above requires information on suitable yardsticks for both input prices and TFP growth. The price cap can be reformulated in a way that eliminates the need for a direct measure of input price changes. This reformulation requires the additional assumption that input price growth at the economy-wide level is a reasonable yardstick as assumed by the Commission's "provisional price cap." However, because there is no available index of composite input prices at the aggregate level, one must measure it indirectly. To do so, we exploit the relationship between the rates of growth of output prices, input prices, and

TFP at the economy-wide level.[1] Letting the subscript "a" denote the (aggregate) economy, one can write this relationship:

$$(10) \quad dp_a = dw_a - dTFP_a$$

Equation (10) allows one to use *output price* inflation and TFP growth at the economy-wide level as an indirect measure of the rate of *input price* inflation at the aggregate level. Solving for dw_a in Equation (10) and substituting it into Equation (9) for dw_t yields the second version of the price cap:

$$(11) \quad dp_m = dp_a - x \quad \text{where } x = dTFP_t - dTFP_a$$

Equation (11) states that output prices be allowed to change at the rate of aggregate (output price) inflation minus an adjustment factor that represents the *differential* between the target and economy-wide rates of TFP growth. This formulation dispenses entirely with the need to compute a separate input price index and preserves the important incentive features. The Commission uses this price cap

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[1] The required assumption for this to hold at the economy-wide level is the ratio of supernormal profits to GNP is (roughly) constant. This assumption has wide currency in the economics literature and empirical support from studies of income shares in the U.S. economy and estimates of the rate of profit on capital. Also note that Equation (10) implies that output price inflation should be negatively correlated with TFP growth (holding constant the rate of input price inflation). There is supporting empirical evidence. The correlation coefficient between the rates of change in the GNPPI and TFP for the domestic private economy (from the Bureau of Labor Statistics) for the period 1960-1987 is -0.67.

formulation for interexchange and local exchange carriers. The primary practical difficulty is how to determine the appropriate x-factor. The Commission relied upon studies of TFP for the telecommunications industry as the yardstick for common carriers, and then adjusted for economy-wide TFP to obtain the differential "x-factor." In MM 92-266, the Commission provisionally adopted this form of price cap for monopoly cable systems, but has not yet resolved determination of the x-factor.

Version 3. The structure of the cable industry makes it possible to use an even simpler, and more easily implementable, form of the price cap. As discussed in the text, the most natural and appropriate procedure is to use competitive cable systems as the yardstick for monopoly cable operators.[2] Letting the subscript "c" denote competitive cable systems, and using Equation (9), we get:

$$(12) \quad dp_m = dw_c - dTFP_c$$

But for competitive systems, the right hand side of Equation (12) is simply the rate of change in competitive cable prices, dp_c. Hence,

$$(13) \quad dp_m = dp_c$$

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[2] For this purpose, competitive cable systems can be defined according to the criteria specified by the Cable Act of 1992, excluding low penetration systems. This and other implementation issues are discussed in Section 3 in the text.

This is my recommended price cap formulation. It is extremely simple: the price change for monopoly cable systems is limited by the price change in competitive cable areas, information which is easily collected. It is important to emphasize that all three versions of the price cap presented here are based on identical economic principles. What makes the particularly simple formulation given in Equation (13) possible for the cable industry is the fact that unregulated competitive systems coexist with regulated monopoly systems in the same industry, and hence can usefully serve as the yardstick both for growth in input prices and TFP.

If the Commission judges that achievable TFP growth for monopoly cable systems differs systematically from competitive systems (e.g., because of demonstrable differences in plant age, technology, population density etc.), the price cap in Equation (13) can be amended to capture this structural difference. The modified form is:

$$(14) \quad dp_m = dp_c - [dTFP_m - dTFP_c]$$

In principle, the bracketed productivity adjustment factor in Equation (14) could be either positive or negative. In any event, this modification should only be adopted if there is substantial evidence of a systematic difference in TFP growth between monopoly and competitive systems.

Dr. Mark Schankerman

Biographical Summary

Dr. Mark Schankerman is currently a tenured faculty member in the Department of Economics at the London School of Economics and Political Science and Research Associate of the National Bureau of Economic Research (Cambridge, Massachusetts). Previously, he held a full-time faculty appointment in the Department of Economics at New York University. He has guest lectured at The Hebrew University, Bacconi University, and the Universite Libre de Bruxelles.

Dr. Schankerman graduated from Brandeis University, A.B. 1972 (Magna Cum Laude in Economics, Phi Beta Kappa) and from Harvard University he received an A.M. degree (1977, Economics) and a Ph.D. (1979, Economics). His academic specializations are the economics of technological change, productivity, and industrial organization (including regulation). His work on the measurement and determinants of productivity growth in the telecommunications industry has been published in numerous periodicals, including Rand Journal of Economics, Economic Journal, and Journal of Econometrics.

Dr. Schankerman testified on behalf of GTE California in the 1988 rate case on the subject of total factor productivity and alternative regulatory frameworks. Most recently, he testified on exogenous factors and post-retirement benefits other than pensions in the California review of the regulatory framework.